In re Application of	:	ARGO-TECH CORPORATION
For	:	**LOW COST GEAR FUEL PUMP**
International Application No.	:	PCT/US2005/04412
International Filing Date	:	14 February 2005 (14.02.2005)
Attorney Docket No.	:	AGTZ 2 00072 PCT

ARTICLE 34 RESPONSE TO THE WRITTEN OPINION OF THE INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

Mail Stop PCT, Attn: IPEA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Dear Sirs:

This Reply is responsive to the Written Opinion of the International Preliminary Examining Authority, mailed 15 November 2005.

Substitute pages 8 and 14-16 are attached in triplicate. These pages amend the claims in the following respects: Claim 1 has been amended to incorporate the subject matter of prior claims 2 and 17. Claim 12 has been amended to incorporate the subject matter of prior claim 17. Claims 2 and 17 have now been canceled. A single copy of the claims marked to show the changes made is also attached.

Page 8 of the specification has been amended to overcome the objections to the drawings. Particularly, reference characters "204" and "206" have been amended to "210" and "212", respectively. Figure 6 has been amended to delete reference character "44'" and include reference character "40'". No new matter is added. Regarding the Examiner's shading requirement for the gear and one-piece bearings, Applicants submit that the powdered material used is ultimately metal once it is sintered and therefore the cross-section showing metal is proper.

The Claims Distinguish over the References of Record

Claim 1 has been amended to incorporate the subject matter of claims 2 and 17. Claim 1 now calls for a gear pump comprising a housing having an interior

pumping chamber, an inlet and an outlet spaced from the inlet. A pair of rotating gears are positioned in the chamber. The gears include teeth which mesh during gear rotation. Each gear is fixedly secured on a shaft having an axis of rotation. A pair of one-piece bearings are located in the chamber and journal one of first and second end portions of each shaft. The one-piece bearings provide precise alignment of the first and second end portions of the shafts and maintain the shafts in parallel relation. The one-piece bearings are manufactured from powdered metal whereby each bearing is homogenous and has a substantially uniform composition throughout.

The Examiner has asserted that claims 1 and 17 lack an inventive step as being obvious over Joy (U.S. Patent No. 5,403,173) in view of Dunn (U.S. Patent No. 3,770,332). The Examiner stated that Joy fails to disclose the material that makes up the bearings. For that teaching, the Examiner relied on Dunn which discloses bearings manufactured from powdered metal. However, Applicants respectfully submit that Dunn does not disclose homogenous one-piece bearings having a substantially uniform composition throughout.

Conversely, Dunn teaches a composite heavy-duty bushing 10 composed of a high performance alloy outer sleeve 12 joined at a generally cylindrical interface to a base metal inner sleeve 16, with opposite end portions 18 of the base metal sleeve expanded into engagement with internal bevels 20 in the outer sleeve. Where the outer sleeve of the composite bushing is a heavy-duty load-bearing component (Figure 4 of Dunn), it is formed from high-performance alloy powder, whereas the less intense load-bearing inner sleeve is formed from powdered iron. (Col. 1, lines 50-59). On the other hand, if the composite bushing is utilized as a bearing bushing 30 for rotatably supporting a shaft in its bore 32, the inner sleeve 36 is manufactured from the high-performance alloy powder and the outer sleeve 34 from the powdered iron (Figure 5 of Dunn). (Col. 1, lines 60-65). Thus, Dunn only discloses a composite bearing and simply fails to teach or even remotely suggest a bushing manufactured from powdered metal whereby the bearing is homogenous and has a substantially uniform composition throughout.

Thus, amended claim 1 now defines over any fair teaching of Joy in combination with Dunn. Accordingly, it submitted that claim 1, and dependent claims 2-11 now meet all the requirements for patentability.

Claim 12 has also been amended to incorporate the subject matter of claim 17. For all the reasons noted above, it submitted that claim 12, and dependent claims 13-16 now meet all the requirements for patentability.

Respectfully submitted,

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15 February 2006
Date

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1. A gear pump comprising:

a housing including an interior pumping chamber;

an inlet to the chamber;

an outlet from the chamber and spaced from the inlet;

a pair of rotating gears in the chamber, the gears including teeth which mesh during gear rotation, each gear being fixedly secured on a shaft having an axis of rotation; and

a pair of one-piece bearings located in the chamber and journalling one of first and second end portions of each shaft, the one-piece bearings providing precise alignment of the first and second end portions of the shafts and maintaining the shafts in parallel relation;

wherein the one-piece bearings are manufactured from powdered metal whereby each bearing is homogenous and has a substantially uniform composition throughout.

2. (Cancelled)

3. The gear pump of claim 1 wherein each one-piece bearing has a generally oblong cross-section.

4. The gear pump of claim 1 wherein each one-piece bearing includes:

a top surface,

a bottom surface,

a pair of openings having center axes coincident with the axes of rotation of the shafts, and

first and second elongated sides, opposing ends of the first side being joined to corresponding opposing ends of the second side by a pair of arcuate ends.

5. The gear pump of claim 4 wherein the first elongated side is parallel to the second elongated side.

6. The gear pump of claim 4 wherein the first and second elongated sides are generally planar.

7. The gear pump of claim 1 wherein each gear is manufactured from powdered metal.

8. The gear pump of claim 7 wherein each gear includes an opening adapted to receive the shaft thereby allowing for self alignment of the teeth of the gears as the gears mesh.

9. The gear pump of claim 1 wherein each shaft includes an axial recess and each gear includes an axial groove dimensioned to receive a pin for preventing rotation of the gears on the respective shafts.

10. The gear pump of claim 1 wherein each shaft includes first and second grooves extending radially about the periphery of each shaft for receiving associated snap rings.

11. The gear pump of claim 1 wherein each gear is secured perpendicularly on each shaft.

12. A method of assembling a gear pump comprising the steps of:

providing first and second shafts having substantially constant diameter along their lengths;

forming a bearing from powder metal whereby the bearing is homogenous;

advancing a gear over each shaft;

securing the gear to each shaft;

mounting ~~a~~ the bearing on the shafts;

installing the bearing and shafts with gears mounted thereon into a housing of a gear pump.

13. The method of claim 12 comprising the further steps of preventing rotation of the gear relative to each shaft.

14. The method of claim 12 comprising the further steps of providing one-piece continuous bearings on each end of the shafts.

15. The method of claim 14 comprising the further steps of journaling each shaft in the one-piece bearings, the one-piece bearings providing precise alignment of the shafts.

16. The method of claim 12 comprising the further steps of forming each gear from powder metal whereby each gear has a substantially uniform composition throughout.

17. (Cancelled)

the volume pumped is a direct function of the volume displaced by the meshing gears, can affect the capacity of the gear pump.

[0051] With reference now to FIGURE 4, a gear pump according to the present invention is shown. Since much of the structure and function is substantially identical, reference numerals with a single primed suffix (') refer to like components (e.g., housing **10** is referred to by reference numeral **10'**), and new numerals identify new components. Likewise, description of components that remain unchanged is not necessary.

[0052] The gear pump assembly **GP'** shown in FIGURES 4-6 includes the housing **10'** having a chamber **200**, defining a single cylindrical bore **202**. The housing **10'** receives a pair of bearings **210**, **212**, each bearing being a one-piece bearing formed from powder metal. That is, the bearings are substantially homogenous components that do not have joint lines, i.e., they are continuous, when compared to the two-piece bearing assemblies of the prior art. Each bearing preferably has a generally oblong cross-section. It will be appreciated that the periphery of each bearing mates with the similarly dimensioned bore **202** of the housing **10'**. However, it should be appreciated by one skilled in the art that the bearings and corresponding bore can have other contours which would allow each bearing to be closely received within the chamber **200** of housing **10'**.

[0053] With reference to FIGURES 8 through 10, the unitary bearing **210**, which is generally longitudinally fixed in the housing, includes a first or top surface **220**, a second or bottom surface **222**, and a pair of openings **224**, **226** having center axes coincident with axes of rotation of shafts or journals **230**, **232**. The bearing further includes first and second elongated sides **236**, **238**. The first elongated side is generally parallel to the second elongated side, and in the preferred arrangement the elongated sides are generally planar. Opposing ends **240, 242** have an arcuate contour, although as stated above, the ends can have other configurations without departing from the scope and intent of the present invention.

[0054] With continued reference to FIGURE 7, the bottom surface **222** of the bearing **210** includes a dam **250**, an inlet face relief **252,** and a discharge face relief **254**. Thus, the bearing dam **250** is located between the inlet face relief and the discharge face relief. The bearing dam wall forms a sealed dam area between an inlet side **256** and an outlet side **258**, thus resulting in a low-pressure area on the inlet side **40'** and high-pressure area on the outlet side **42'** of the gear pump **GP'**. The bearing further includes

What is claimed is:

1. (Amended) A gear pump comprising:

a housing including an interior pumping chamber;

an inlet to the chamber;

an outlet from the chamber and spaced from the inlet;

a pair of rotating gears in the chamber, the gears including teeth which mesh during gear rotation, each gear being fixedly secured on a shaft having an axis of rotation; and

a pair of one-piece bearings located in the chamber and journaling one of first and second end portions of each shaft, the one-piece bearings providing precise alignment of the first and second end portions of the shafts and maintaining the shafts in parallel relation;

wherein the one-piece bearings are manufactured from powdered metal whereby each bearing is homogenous and has a substantially uniform composition throughout.

2. (Cancelled)

3. The gear pump of claim 1 wherein each one-piece bearing has a generally oblong cross-section.

4. The gear pump of claim 1 wherein each one-piece bearing includes:

a top surface,

a bottom surface,

a pair of openings having center axes coincident with the axes of rotation of the shafts, and

first and second elongated sides, opposing ends of the first side being joined to corresponding opposing ends of the second side by a pair of arcuate ends.

5. The gear pump of claim 4 wherein the first elongated side is parallel to the second elongated side.

6. The gear pump of claim 4 wherein the first and second elongated sides are generally planar.

7. The gear pump of claim 1 wherein each gear is manufactured from powdered metal.

8. The gear pump of claim 7 wherein each gear includes an opening adapted to receive the shaft thereby allowing for self alignment of the teeth of the gears as the gears mesh.

9. The gear pump of claim 1 wherein each shaft includes an axial recess and each gear includes an axial groove dimensioned to receive a pin for preventing rotation of the gears on the respective shafts.

10. The gear pump of claim 1 wherein each shaft includes first and second grooves extending radially about the periphery of each shaft for receiving associated snap rings.

11. The gear pump of claim 1 wherein each gear is secured perpendicularly on each shaft.

12. (Amended) A method of assembling a gear pump comprising the steps of:

providing first and second shafts having substantially constant diameter along their lengths;

forming a bearing from powder metal whereby the bearing is homogenous;

advancing a gear over each shaft;

securing the gear to each shaft;

mounting the bearing on the shafts;

installing the bearing and shafts with gears mounted thereon into a housing of a gear pump.

13. The method of claim 12 comprising the further steps of preventing rotation of the gear relative to each shaft.

14. The method of claim 12 comprising the further steps of providing one-piece continuous bearings on each end of the shafts.

15. The method of claim 14 comprising the further steps of journaling each shaft in the one-piece bearings, the one-piece bearings providing precise alignment of the shafts.

16. The method of claim 12 comprising the further steps of forming each gear from powder metal whereby each gear has a substantially uniform composition throughout.

17. (Cancelled)